

LA-UR-18-31223

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Intended for: For air sampling program information

Issued: 2018-11-30

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Pressure Drop Measurement of Bladewerx Speclon™ 5 filter

November 18, 2018

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Materials and Methods

In November 2018, the Aerosol Engineering Facility measured the pressure drop of Speclon™ 5 air filter material at filter face velocities 0.067, 0.677, and 2.165 m/s. This is referred to as “New Speclon 5” (received in November 2018) for this document. For comparison, the pressure drop of “Speclon 5” filter (received in July 2018) was also measured at five different filter velocities between 0.067 m/s and 2.165 m/s.

An experimental FEF (Filter Efficiency and Flow) system (Moore et al 2018) was developed at Los Alamos TA-03-0130 (Aerosol Engineering Facility) for measuring the filter pressure drop and the filter collection efficiency at representative flowrates (Figures 1 and 2).

In the FEF system (Figures 1 and 2), the FPC101 pump pulls air through the tested filter located in the FLT1 filter holder (Fisher Inc). The filter holder (Moore et al 2018) with plastic cassette and steel mesh backing material (Figure 3) has mechanical features that eliminate edge leakage and reduce the inconsistency of test results (i.e. flow rate versus pressure drop) due to irregular and/or imperfect filter seal mechanisms (ASTM 2014). The pressure drop values were recorded in units of inHg (i.e. inches of mercury), but converted to Pa (Pascals) that correspond to the filter face velocities (m/s, i.e. meter per second).

For this report, three individual 47 mm diameter filters (“New Speclon 5” or “Speclon 5”) were inserted into three different filter cassettes (Fisher Inc. No. 59-004648-0010). The Fisher™ cassettes have an active filter diameter of 39 mm. For a measurement on a single filter, the holder’s conical aluminum inlet portion was threaded and tightened until the holder’s internal O-rings were in physical contact with the cassette, then the conical inlet was hand-tightened one-quarter turn.

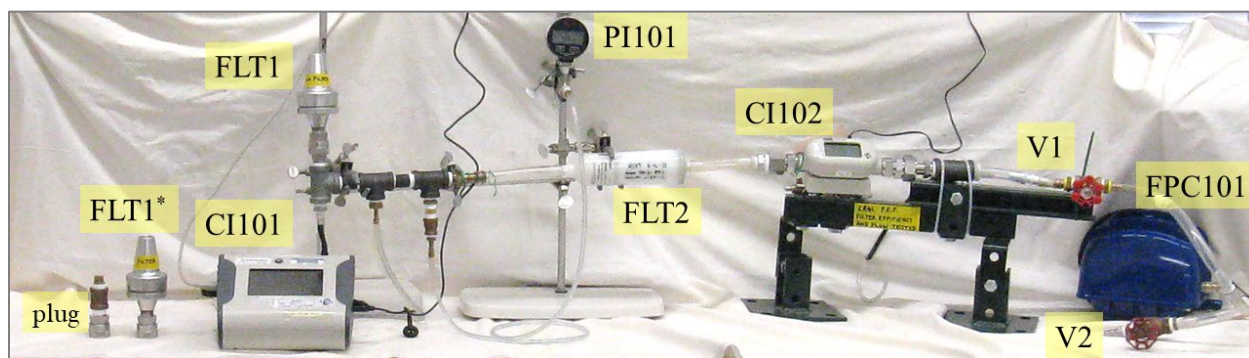


Figure 1. The LANL FEF (Filter Efficiency and Flow) test system

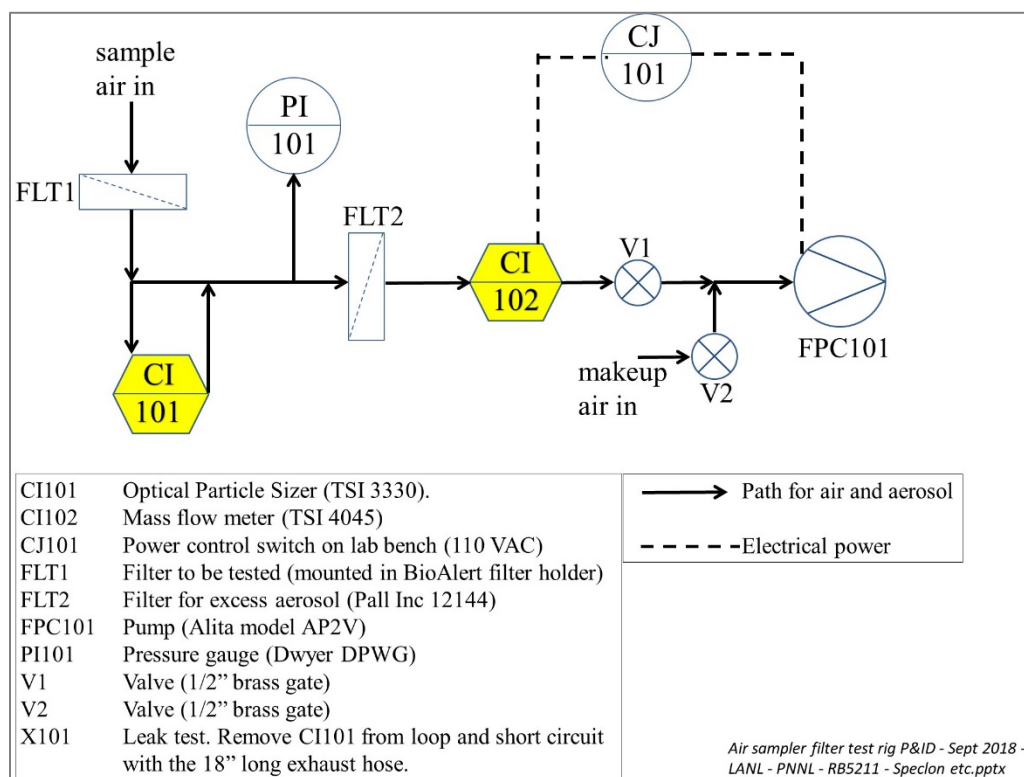


Figure 2. The LANL FEF P&ID (process and instrumentation diagram).



Figure 3. Fisher™ filter holders and cassettes.

Results

The filter face velocity versus pressure drop was fitted to a second order polynomial function (Figure 4).

$$\Delta P = aV^2 + bV$$

where

a = coefficient due to inertial effects of the fluid flow in the filter system (Fain 1986), and

b = coefficient due to (viscous) Darcy's law (ASTM 2014).

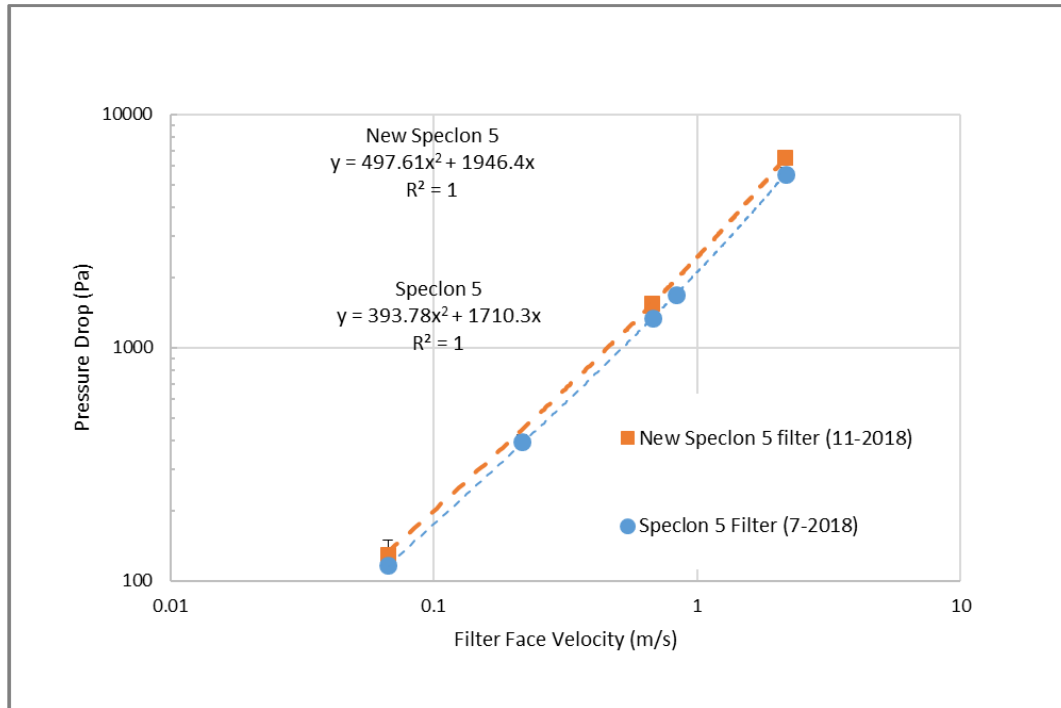


Figure 4. The filter face velocity versus pressure drop

Table 1. Velocity, flowrate and pressure drop through an equivalent 25 mm filter (active diameter).

V, m/s	Q, ALPM	“New Speclon 5” Average Pressure drop (Pa)	“Speclon 5” Average Pressure drop (Pa)	Percent Difference, %
0.067	2.0	129	117	9%
0.677	19.9	1546	1343	13%
2.165	63.8	6546	5549	15%

Discussion and Conclusions

The pressure drop of “New Speclon 5” filter is higher than the “Speclon 5” filter (received in July, 2018) at the filter face velocity from 0.067 to 2.165 m/s.

Future Work

Further measurements, such as aerosol collection efficiency, optical microscopy, and the FWHM (full width half maximum, keV) of the alpha energy spectrum of naturally occurring radon progeny can be measured.

References

- ASTM F778. 2014. Standard Methods for Gas Flow Resistance Testing of Filtration Media.
- Fain DE. 1986. Standards for pressure drop testing of filters as applied to HEPA filters. ASTM special technical publication, (975), 364-379.
- Moore ME, CT Simpson, TD McLean, Y Tao, JT Voss and JA Stephens. 2018. Measuring air sampler filter material for pressure drop, aerosol collection efficiency, alpha spectrum FWHM resolution and radon progeny collection. Los Alamos National Laboratory Unrestricted Release. LAUR-18-30267.